COURSE DESCRIPTION CARD - SYLLABUS

Course name

TRENDS IN THE DEVELOPMENT OF CHEMICAL TECHNOLOGY AND SEPARATION TECHNIQUES FOR SUSTAINABLE DEVELOPMENT – CASE STUDIES

Course

Proposed by Discipline
Chemical sciences

Year/Semester
II/4, III/6

Type of studies
Doctoral School

Course offered in
English

Form of study
full-time

Requirements
elective

Number of hours

Lecture	Tutorials	Projects/seminars
4		

Number of credit points

1

Lecturers

Responsible for the course/lecturer:
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Responsible for the course/lecturer:
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Prerequisites

Knowledge: PhD student knows the principles of environmental protection related to chemical production and waste management.

Skills: PhD student can obtain information from literature, databases and other sources of chemical and environmental sciences, he/she can interpret them, draw conclusions, and formulate opinions.

Social competencies: PhD student understands the need for further education and improvement of his/her professional and personal competences.

Course objective

Extending knowledge of separation techniques application on industrial scale for sustainable development in chemical technology.

Course-related learning outcomes

Knowledge

A PhD student who graduated from doctoral school knows and understands:
1) to the extent that enables revision of existing paradigms - global achievements, covering theoretical basis as well as general and selected specific issues, that are specific to scientific disciplines studied at the doctoral school, [P8S_WG/SzD_W01]
2) key developmental trends of science disciplines in which education takes place at the doctoral school, [P8S_WG/SzD_W02]
3) fundamental dilemmas of the contemporary civilization, [P8S_WK/SzD_W05]
4) economic, legal, ethical and other vital conditions related to scientific activity. [P8S_WK/SzD_W06]

Skills

A PhD student who graduated from doctoral school can:
1) critically analyze and asses scientific research results, work of experts and other creative activities together with their contribution into knowledge development, [P8S_UW/SzD_U02]
2) take part in scientific discourse. [P8S_UK/SzD_U07]

Social competences

A PhD student who graduated from doctoral school is ready to:
1) critically assess the achievements within a given scientific discipline. [P8S_KK/SzD_K01]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

PQF code	Methods for verification of learning outcomes	Assessment criteria
W01, W02, W05, W06,	written exam	3.0 (50.1 - 60.0%) 3.5 (60.1 - 70.0%) 4.0 (70.1 - 80.0%) 4.5 (80.1 - 90.0%) 5.0 (from 90.1%)
U02, U07	written exam	as above
K01	written exam	as above

Programme content

1. Recovery of metals from primary (e.g. copper ores) and secondary (e.g. spent automotive catalysts, spent batteries) resources, significance of metals (copper, cobalt, nickel, platinum group metals, rare earth elements) for high-tech production and economy, pyro-, hydro- and electrometallurgy in metal recovery – advantages and disadvantages, primary resources – copper recovery from Polish (pyrometallurgical process, KGHM Polska Miedź) and Chilean copper ores (hydrometallurgical process), Secondary resources: pyrometallurgy for recovery of Platinum Group Metals from spent automotive

catalysts, hydrometallurgy for cobalt, nickel and REE recovery from spent NiMH and Li-ion batteries).
2. Membrane separation as green technologies for water, soil and air purification (Classification of membrane techniques; Characteristic of membranes; Multistage Membrane Separations, Desalination of seawater for potable and technological water, Membrane separation of organic compounds obtained by biosynthesis (e.g. production of carboxylic acids), Current Technical Trends in the Gas Separation (removal of CO2).

Teaching methods

Lecture: multimedia presentation including illustrations and examples.

Bibliography

Basic

1. C. A. M. Afonso, J.P. Crespo, P.T. Anastas, Green Separation Processes: Fundamentals and Applications, Wiley, Weinheim 2005 (e-book).

2. C. K. Gupta, Chemical Metallurgy: Principles and Practice, Wiley, Weinheim 2003 (e-book).

3. E. Drioli, A. Criscuoli, E. Curcio, E. Curcio, Membrane Contactors : Fundamentals, Applications and Potentialities, Elsevier, Amsterdam 2006.

Additional

1. J. Szymanowski, Hydroxyoximes and Copper Hydrometallurgy,1st Ed., CRC Press, Boca Raton 1993.

2. K. Wieszczycka, B. Tylkowski, K. Staszak (Eds.), Metals in Wastes, DE GRUYTER, Berlin 2018.

3. Z. F. Cui, H. S. Muralidhara, Membrane Technology, A Practical Guide to Membrane Technology and Applications in Food and Bioprocessing, 1st Edition, Butterworth-Heinemann 2010, Hardcover ISBN: 9781856176323; eBook ISBN: 9780080951348.

Breakdown of average student's workload

	Hours	ECTS
Total workload	22	1.0
Classes requiring direct contact with the teacher	6	0.5
Student's own work (literature studies, preparation for tutorials, project preparation) [1]	16	0.5

[1] delete or add other activities as appropriate